§54.15–15 Relief devices for unfired steam boilers, evaporators, and heat exchangers (modifies UG–126).

(a) An approved safety valve set to relieve at a pressure not exceeding the ''maximum allowable working pressure'' of the shell shall be fitted to all unfired steam boilers and evaporators except for evaporators of the atmospheric type designed for vapor discharge direct to a distiller with no shutoff valve in the discharge line. The distiller connected to atmospheric evaporators shall be fitted with a vent to prevent a buildup in pressure. In no case shall the vent be less than 1½ inches in diameter. Evaporators operating between atmospheric pressure and 15 p.s.i.g., may use a rupture disc as an alternative to the safety valve.

(b) Safety valves for use on pressure vessels in which steam or pressure is generated shall comply with the requirements of §54.15–10. Rupture discs used in lieu of these safety valves, as provided for in paragraph (a) of this section, shall comply with the requirements of §54.15–13.

(c) The relieving capacity of evaporator safety valves required by paragraph (a) of this section shall be at least equal to the capacity of the orifice fitted in the steam supply to the evaporator. The orifice capacity shall be determined in accordance with the formula in paragraph (c) (1) or (2) of this section as appropriate:

(1) Where the set pressure of the evaporator shell safety valve is 58 percent or less than the setting of the safety valve in the steam supply:

$$W=51.45AP$$

(2) Where the set pressure of the evaporator shell safety valve exceeds 58 percent of the setting of the safety valve on the steam supply:

$$W=105.3A\sqrt{P_1(P-P_1)}$$

where:

W=The required orifice capacity, in pounds per hour.

A=Cross-sectional area of rounded entrance orifice, in square inches. The orifice shall be installed near the steam inlet or the coils or tubes and where no orifice is employed the area used in the formula shall be that of the inlet connection or manifold.

P=Set pressure of steam supply safety valve, in pounds per square inch, absolute.

P_1=Set pressure of evaporator shell safety valve, in pounds per square inch, absolute.

(d) The relieving capacity of safety valves on unfired steam boilers shall not be less than the maximum generating capacity of the unfired steam boiler as certified by the manufacturer.

(e) On new installations and where the orifice size of an existing unfired steam boiler or evaporator is increased, an accumulation test shall be made by closing all steam outlet connections except the safety valves for a period of five minutes. When conducting the accumulation test, the water shall be at the normal operating level and the steam pressure shall be at the normal operating pressure, and while under this test the pressure shall not rise more than 6 percent above the safety valve setting.

(f) A heat exchanger with liquid in the shell and the heating medium in the tubes or coils, shall be fitted with a liquid relief valve meeting the requirement of §54.15–5.

(g)(1) A heat exchanger with steam in the shell and liquid in the tubes or coils at a pressure exceeding that in the shell, shall have a liquid relief valve fitted to protect the shell against excess pressure.

(2) The discharge capacity of such relief valves shall be calculated on the basis of the discharge from one tube using the difference in pressures between that in the shell and that in the tubes and shall be not less than that determined by the following formula:

$$Q=29.81KD^2\sqrt{P_1-P_2}$$

where:

Q=Required relief valve discharge capacity, in gallons per minute, based on relief valve set pressure.

P_1=Pressure in the tube or coils, in pounds per square inch.

P_2=Set pressure of the shell relief valve, in pounds per square inch.

D=Internal diameter of the largest tube or coil, in inches.

K=Coefficient of discharge=0.62.

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